

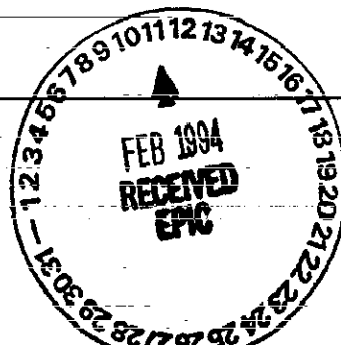
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ACRONYMS

CAMU	Corrective Action Management Unit
CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act</i>
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERDF	Environmental Restoration Disposal Facility
NPH	natural phenomena hazard
NRC	U.S. Nuclear Regulatory Commission
PC	performance category
RCRA	<i>Resource Conservation and Recovery Act</i>
SCC	structures, systems, and components
SDC	standard structural design criteria

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1.0 INTRODUCTION

This report provides information on the seismic hazard for design of the proposed Environmental Restoration Disposal Facility (ERDF), a facility designed for the disposal of wastes generated during the cleanup of Hanford Site aggregate areas. The preferred ERDF site is located south and east of 200 East and 200 West Areas (Figure 1).

The Washington State Groundwater Protection Program (WAC 173-303-806 (4)(a)(xxi)) requires that the characteristics of local and regional hydrogeology be defined. A plan for that work has been developed (Weekes and Borghese 1993). In addition, WAC 173-303-282 provides regulatory guidance on siting a dangerous waste facility, and U.S. Department of Energy (DOE) Order 5480.28 requires consideration of natural phenomena hazards mitigation for DOE sites and facilities. This report provides information to evaluate the ERDF site with respect to seismic hazard. The ERDF will be a Corrective Action Management Unit (CAMU) as defined by 40 CFR 260.10.

2.0 FACILITY DESCRIPTION AND WASTE DESCRIPTION

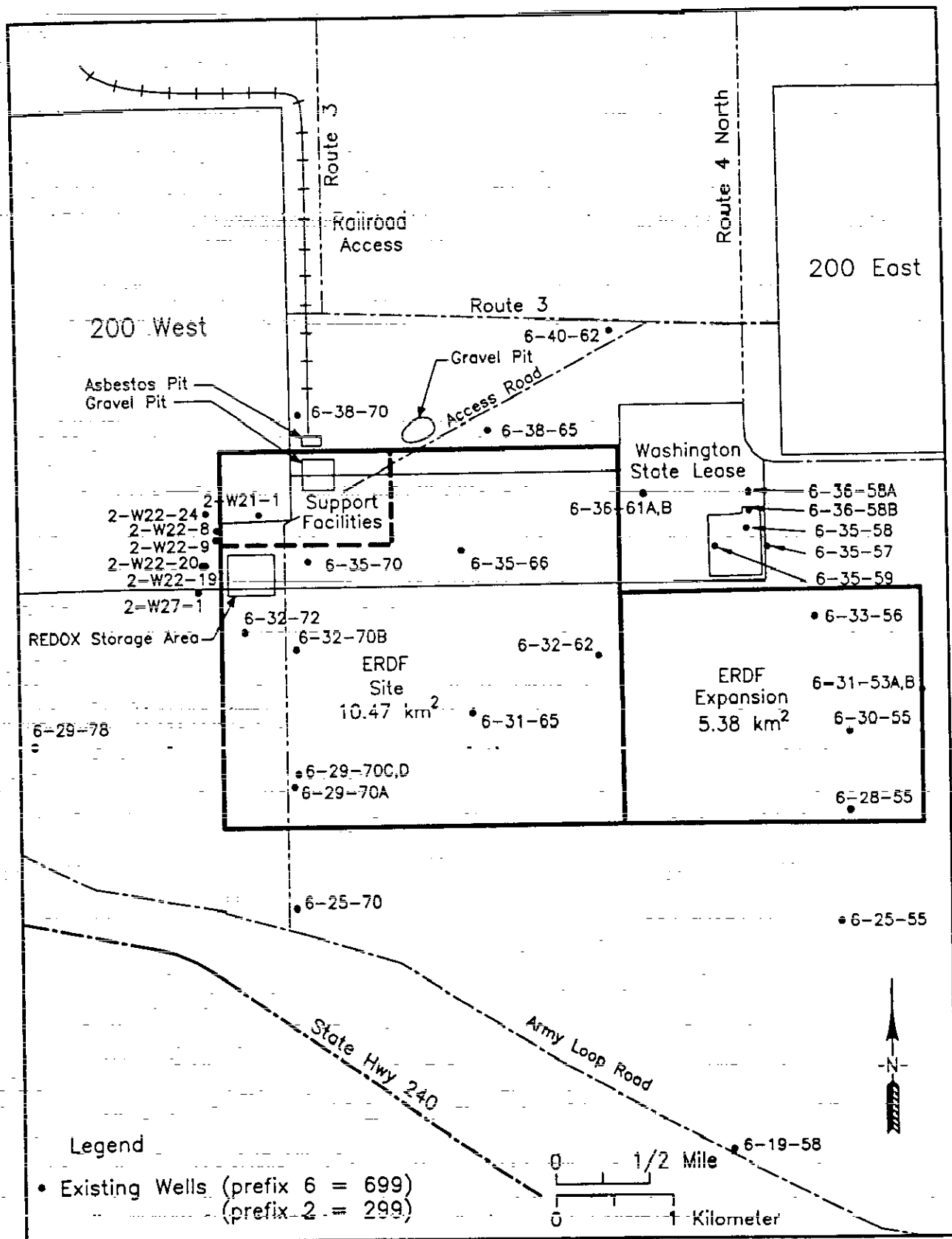
The ERDF is proposed to manage remediated waste from the Hanford Site in a CAMU designated by the U.S. Environmental Protection Agency (EPA) for the purpose of facilitating remediation waste management activities from the Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) facilities in compliance with Subpart S of 40 CFR 264.552. The proposed ERDF could receive material generated by the Environmental Restoration (ER) program during remediation of the Hanford Site (WHC 1993a and 1993b). Approximately 22 million m³ (28.5 million yd³) of material will be generated from remedial actions on past-practice waste units. Contaminated soil from the 100 Area and 300 Area operable units, as well as some 200 Area operable unit waste, will be disposed in the proposed ERDF. The soils will likely have elevated levels of various radionuclides and/or hazardous constituents.

The site covers approximately 15.85 km² (6.12 mi²): 10.47 km² (4 mi²) for primary disposal and 5.38 km² (2.1 mi²) for expansion, if needed. Siting and land requirements for the proposed ERDF are presented in the site evaluation report (WHC 1993c).

2.1 DESIGN

The proposed ERDF is expected to consist of lined and unlined trenches and support facilities (DOE-RL 1993b). The primary disposal site may cover 10.47 km² (4 mi²) based on the 22 million m³ (28.5 million yd³) estimate for ER generated waste, the configuration of the disposal units, and the design of the disposal units and the support facilities. A 5.38 km² (2.1 mi²) expansion area is set aside for possible future disposal.

Figure 1. Location Map of the Proposed ERDF.



2.2 REGULATORY REQUIREMENTS

2.2.1 WAC 173-303-281

Washington Administrative Code 173-303-282, Siting Criteria, provides an initial screen for the consideration of sites for dangerous waste management facilities. Under Section 6, "Criteria for Elements of the Natural Environment" (i) Seismic Risk:

All dangerous waste management facilities shall be located such that the dangerous waste management unit boundary is located at least five hundred feet from a fault which has had displacement in Holocene times.

2.2.2 DOE Order 5480.28

DOE Order 5480.28 requires the following of DOE:

to establish Department of Energy policy and requirements for natural phenomena hazard (NPH) mitigation for DOE sites and facilities using a graded approach.

This order requires all structures, systems, and components to be designed and constructed to withstand the effects of natural phenomena hazards. It is intended that all new structures comply with this order. Site planning for new structures must consider all consequences of NPH. This includes seismicity, geological hazards, soil failure, wind, and flood plains.

Natural phenomena hazard design and evaluation requirements given in the order require a probabilistic assessment of the likelihood of future NPH occurrence. The level of NPH assessment to be conducted is to be appropriate for the performance categories being considered in a manner consistent with the graded approach.

Structures, systems, and components (SSC) are assigned to one of five performance categories (PC) in accordance with performance categorization criteria given in the applicable DOE standard. For seismic hazard, the applicable DOE Standard is UCRL-15910, which is currently being revised as Draft DOE Standard 1020. Goals and performance categories are selected by engineers with knowledge of systems, safety requirements, and facility operations in a manner that meets DOE safety policies.

The five performance categories are as follows:

- 1) PC 0--No consideration of natural phenomena is necessary.
- 2) PC 1 and PC 2--These have NPH provisions consistent with model building codes, where ensuring life safety for onsite personnel or continuity of essential operations is an issue of importance. For PC 1 SSC, the primary concern is preventing major structural damage or collapse that would endanger personnel. PC 2 SSC are of greater importance because of mission-dependent considerations.

They may also pose a greater danger to onsite personnel than PC 1 SSC because of operations or hazardous materials within the SSC. The PC 2 performance goal is consistent with the design criteria for essential facilities (e.g. hospitals, fire and police stations, and centers for emergency operations) in accordance with model building codes.

3) PC 3 and PC 4--These pose a potential hazard to worker or public health and safety and to the environment because radioactive or toxic materials are present in significant quantities. PC 3 NPH provisions are consistent with those used for re-evaluation of commercial plutonium facilities with conservatism in between that of model building code requirements and civilian nuclear power plant requirements. PC 4 seismic provisions are consistent with those used for re-evaluation or design of civilian nuclear power plants, where offsite release of hazardous material must be prevented.

2.3 HAZARD CLASSIFICATION OF THE ERDF

A study was performed to determine the hazard classification of the ERDF (WHC 1993a). The purpose of this study was to (1) establish the review and authorization level of the safety analysis and (2) provide a basis for applying a graded approach to the level of analysis and documentation of safety analysis reports. The hazard classification was concluded to be low.

3.0 GEOLOGY AND SEISMIC HAZARDS

3.1 GENERAL GEOLOGY

The geology of the Columbia Basin and Hanford Site has been discussed in numerous reports and will not be repeated here. A good summary of the site geology is provided in DOE (1988) and Reidel et al. (1992). The most recent study on the structural geology and history of deformation at the Hanford Site is by Reidel et al. (1987, 1993).

The Hanford Site is located in the Pasco Basin, a large topographic and structural basin in the Yakima Fold Belt. The Yakima Fold Belt and the Palouse Slope are the two major structural subprovinces of the Columbia Basin. The Palouse Slope is a relatively undeformed area that occupies the eastern part of the Columbia Basin, and the Yakima Fold Belt is the western Columbia Basin.

The Columbia Basin has a long and complex structural history. The anticlinal ridges and synclinal valleys began developing soon after the initial eruptions of the Columbia River Basalt Group over 17 million years ago. These folds continued to develop after the eruptions ceased, and data indicate that the folds continue to grow. The estimated contemporary growth rate for the folds is approximately 0.04 mm/year (range 0.02 to 0.06 mm/year) based on extrapolated geologic data.

3.2 SEISMIC HAZARD ANALYSIS

It has long been realized that an earthquake in the Yakima Fold Belt structures might affect the nearby nuclear or hydroelectric facilities in the Columbia Basin area. It is for this reason that extensive geologic and geophysical investigations have been conducted throughout this specific area and the surrounding Columbia Plateau since the 1970's. In the case of the nuclear facilities at Hanford, a combination of deterministic and probabilistic seismic hazard analysis methods have been employed to provide the basis for evaluating existing facilities and to serve as the design basis for new structures. In these assessments, the nearby geologic structures have been conservatively assumed to be seismogenic, even in the absence of field evidence for recent faulting. So called "random" earthquakes have also been used in this process to "capture" uncertainties in activity or location of earthquakes.

The seismic hazard at a site is a function of the location and geometry of potential sources of future earthquakes, the frequency of occurrence of various sized earthquakes on these sources, and the characteristics of seismic wave propagation in the region. This section summarizes the seismic hazard and the seismic hazard analysis that has been done for the Hanford Site. The most recent seismic hazard analysis for the Hanford Site was a probabilistic analysis done by Geomatrix for Westinghouse (WHC 1993b).

3.2.1 Methodology

A probabilistic seismic hazard analysis defines the likelihood that various levels of ground motion will be exceeded during a specified time period. The analysis procedure was originally proposed by Cornell (1968), and the procedure has evolved since that time as more is understood about the earthquake process and techniques for evaluating seismological, geological, and geophysical data. The analysis performed by Geomatrix Consultants, Inc. at the Hanford Site (WHC 1993b) is a state-of-the-art analysis using the most recent geologic data and tectonic models. The models, parameters, and their relative weights presented in that report represent a consensus of a team developed through multiple meetings and discussions.

3.2.2 Seismic Hazard Model

The seismic hazard model consists of two basic components: a model of the sources of potential future earthquakes, and a model of the effects of ground motion at the site of future earthquakes. Each potential earthquake source is characterized by parameters that describe its location, geometry, maximum magnitude, and earthquake recurrence. A complete discussion of the development of the model and its uncertainty is presented in WHC (1993b).

3.3 SEISMIC SOURCES

Earthquake activity in the Columbia Basin is attributed to three separate source regions of the seismogenic crust: fault sources expressed at the surface by the Yakima folds and related reverse/thrust faults, a shallow

basalt source that accounts for the observed seismicity within the Columbia River Basalt Group and is not spatially associated with the Yakima folds, and a crystalline basement source region that extends from the top of the crystalline basement to the base of the seismogenic crust. These seismic sources are discussed in DOE (1988) and summarized by WHC (1993b). They form the basic framework for their seismic hazard analysis.

3.4 CAPABLE FAULTS AT THE HANFORD SITE

Figure 2 shows the most recent compilation of published and unpublished geology from the ERDF site (Reidel and Fecht 1993a, 1993c). These maps show all the known faults and folds near the ERDF site. The faults are associated with the anticlinal ridges that make up the Yakima-Fold Belt. Two faults, the Cold Creek fault and the May Junction fault, are located within the Cold Creek syncline. Both these faults are very limited in length compared to the faults associated with the anticlinal ridges.

All the faults on the Hanford Site are considered to have some finite probability of being "capable" faults following Nuclear Regulatory Commission (NRC) nuclear plant licensing criteria. This approach was taken to be conservative; however, only the Central Gable Mountain fault has been shown to have post-13,000-year movement. The Smyrna Bench segment of the Saddle Mountains fault has long been suspected of having late Quaternary-Holocene movement (Reidel et al. 1993), but no conclusive data has been found. The nearest known fault to the ERDF facility is the Yakima Ridge fault at a distance of 3 km.

4.0 SEISMIC HAZARD ANALYSIS RESULTS

Figure 3 presents the computed mean peak hazard and computed uncertainty for the 200 West area for peak acceleration and 5% damped spectral accelerations at periods of 0.3 and 2.0 seconds. The uncertainty bands vary from about one order of magnitude at low ground motion levels to over two orders of magnitude at large ground motion levels. The uncertainty in the computed hazard also increases as one considers longer periods of vibration. The distribution in computed frequency of exceedance becomes skewed at the higher ground motion levels, and the mean hazard lies near the 75th percentile of the hazard distribution. The 200 East Area is essentially the same as the 200 West Area.

5.0 CONCLUSIONS

The low-hazard ERDF facility has a performance goal of 10^{-3} as outlined in Kennedy et al. (1990). The 10^{-3} ground motion is about 0.13 g (acceleration of gravity). The Hanford Plant Standard Structural Design Criteria (SDC) (WHC 1989) gives the peak ground acceleration of 0.12 g for a low hazard. Guidance in WHC (1989) is appropriate for use on this facility.

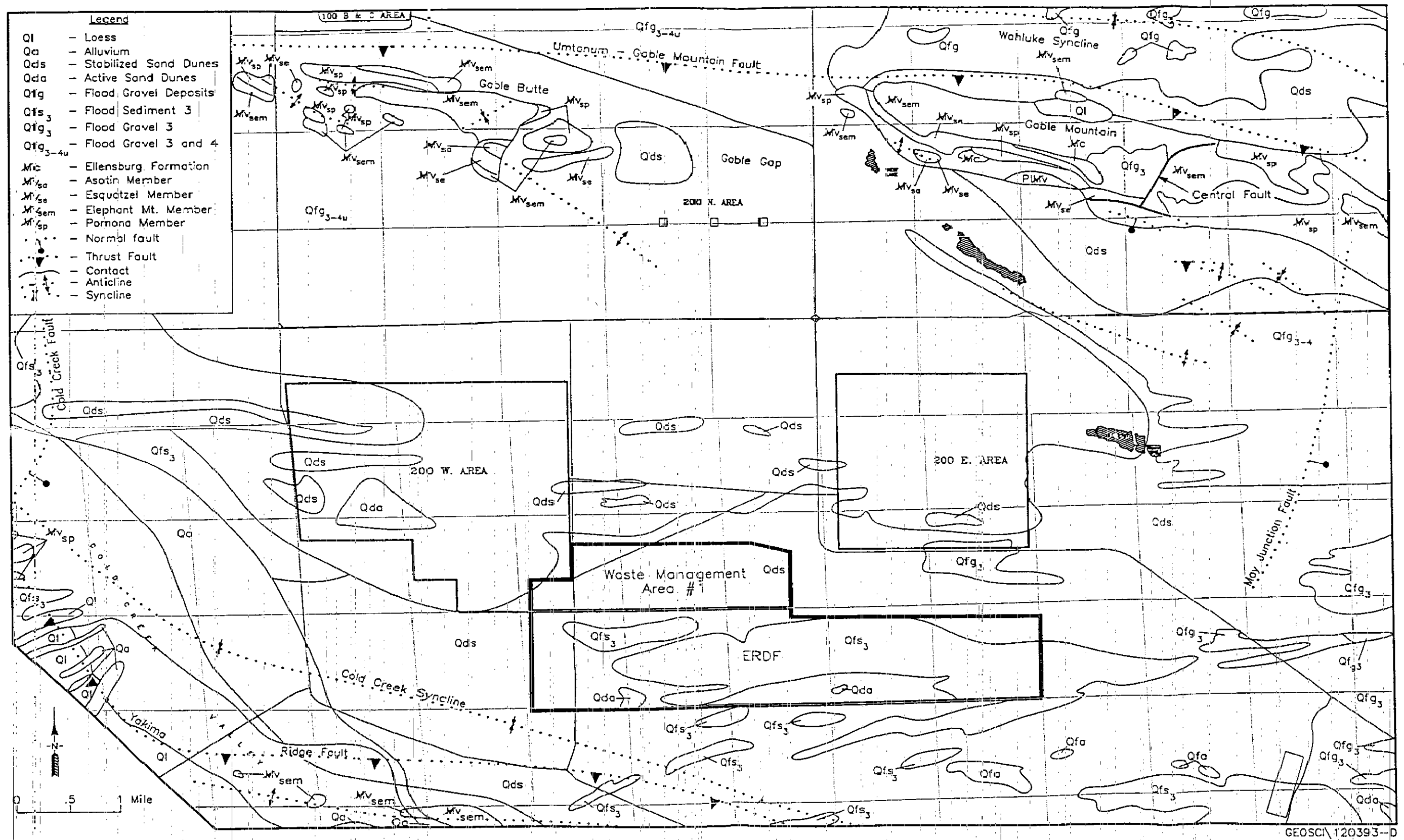
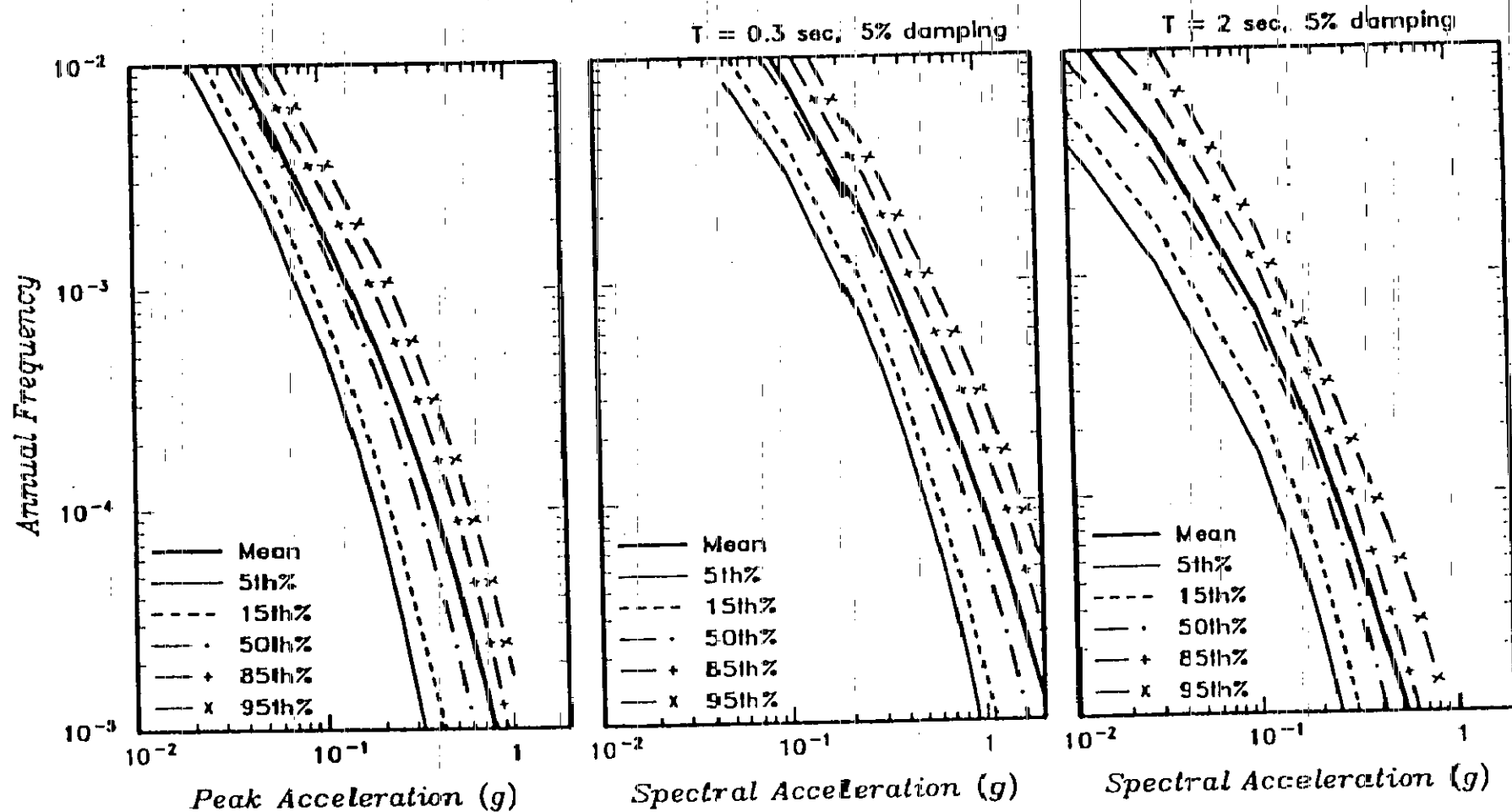
Figure 2. Geologic Map of the
Showing All Known Faults

Figure 3. Computed Mean and 5th to 95th Percentile Hazard Curves for the 200 West Area.



site a with subduction zone 12/7/93

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